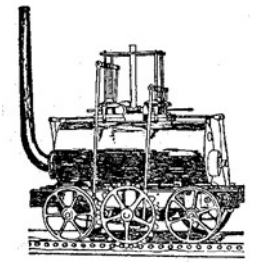
Middleton Railway Trust

Cranage Handbook



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Introduction

This handbook is designed to help people to carry out the roles of Crane Driver, Banksman and Slinger in a working environment, providing guidance on how the relevant rules and regulations from the Middleton Railway Rule Books apply when cranes are in use at the railway. This handbook covers all roles, and whilst some information is specific to Crane Driver duties – of which there are only ever a limited number competent in this role – it is beneficial for all roles involved in craning to have an appreciation of such aspects.

The minimum age for anyone to undertake Crane Banksman duties is 18. A person may be a Slinger – effectively acting as an assistant to the Banksman or undertaking training to become a Banksman – from 16 years of age. However they will acting under the supervision of a Certified Banksman and must follow their instructions. Until certified competent as a Banksman, persons may only perform these duties whilst supervised by a person certified competent for the grade being operated. At all times, anyone under training, supervision or assisting with the operations must listen to, and follow, all instructions from the person supervising.

To become a certified Crane Banksman, you will need to undertake an assessment to demonstrate an understanding of the applicable rules & regulations, the theory of craning, and suitable experience through physical tests of craning activities.

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This handbook must not be used alone, but in conjunction with practical experience and consultation of the Engineering Regulations and Company Rulebook, General Regulations and Train Operating Regulations where relevant. Guidance is also available from the Health & Safety Executive (HSE) and industry.

Remember, this handbook cannot cover every eventuality you may encounter, so seek as much guidance and experience as possible – if in doubt, ask!

Definitions

The following definitions are used within this handbook and may be referenced during lifting / craning operations.

Throughout this handbook, any reference to a person uses the masculine form, however will be taken to mean any gender.

Jib	Main structure, Carries the lifting rope.
Jibbing, Luffing or Booming	The movement of the jib up or down to increase or decrease the radius of the crane
Chain Sling	Portable piece of lifting equipment which is attached to the crane hook and used for lifting loads – made from steel.
Crane Ropes	Typically a stranded steel wire and 2 per crane; one is used for lifting and lowering loads and the other for lifting and lowering the jib
Drum	Any spool on which the crane ropes are wound
Hoisting	The action of raising and lowering loads using the hook
Hook	A part of the crane that is attached to the end of the crane lifting rope where the load can be hung
Hook Block	The housing within which the hook sits (only where there are two or more falls)
Jib Length or Radius	The length of the jib from its pivot point on the crane carriage to the pulley centreline
Safe Load Indicator	A device in the cab that indicates when the load exceeds the safe working limit for the radius
Outrigger	Steadying devices to prevent crane tipping
Reeving	The passing of crane ropes over pulleys to give a mechanical advantage
Safe Working Load (SWL)	The maximum load that can be lifted by a crane operating at a given radius. Indicated by a load / radius indicator on side of jib. SWL also applies to lifting equipment such as chains and slings.
Slewing	The rotation of the crane body around its centre point
Sling	Portable piece of lifting equipment which is attached to the crane hook and used for lifting loads.
Suspension Rope	Wire ropes that support the jib
Tag Line / Guide Ropes	A non load bearing rope, used by people on the ground to steady a load
Working Area	The area in which crane operations will take place, plus a margin for safety

Daily Crane Checklist CR2 Yellow Crane

Inspection A - Daily when in use, to be carried out by the driver

Check level of water in radiator					
Check level of fuel in tank					
Check level of oil in engine					
Check level of oil in torque converter					
Check all drive belts					
Check couplings for damage, missing pins and security					
Check lifting brake to ensure clear of water. Clear as necessary					
Check setting of jib brake and adjust if necessary					
Check brakes for correct operation, adjustment, missing pins and security					
Operate Automatic lubrication system until full pressure reached for both positions					
Check audible warning device					
Check security of pins and attachments of ropes					
Carry out brake holding test on lifting brake - to hold full power with brake applied					
Check operation of rope load indicator (WYLIE)					
Check load indicator has free movement and moves as jib is raised and lowered.					

Daily Crane Checklist CR1 Grey Crane

This is part of form showing checks.

For working forms. Please check “Crane” folder under signing on desk.

MIDDLETON RAILWAY

Cranes

Check List CR1   Ver 2   06/21

CRANE NO: 20054 (Grey Crane)

Inspection A - Daily when in use, to be carried out by the driver

No.	Check
1	Check level of water in radiator
2	Check level of fuel in tank
3	Check level of oil in engine
4	Check level of oil in torque converter
5	Check all drive belts
6	Check couplings for damage, missing pins and security
7	Check travel brakes for correct operation, adjustment, missing pins and security
8	Check operation of lifting brake
9	Check and open chain lubricators.
10	Lubricate crane crown wheel .(Thick Oil)
11	Check audible warning device
12	Check security of pins and attachments of ropes
13	Check load indicator has free movement and moves as jib is raised and lowered.

Date

Signed

/ No fault found/Action completed
X Defective
O Not examined
N Not in use
- Not Applicable

N.B. This list is not exhaustive and the driver should report any defects found on the rear of this sheet

What is ‘Craning’?

Craning, in the context of the Middleton Railway, is the term given to lifting operations using a rail mounted crane. Craning typically involves lifting heavy and / or bulky objects than can give rise to significant danger if not lifted and moved safely. This handbook will provide guidance on typical lifting operations at the Middleton Railway, and how they can be undertaken safely.

Alternative cranes such as road cranes may be in use at the Middleton Railway, and whilst many of the same principles outlined in this handbook will apply, these cranes are infrequently used and may come with their own crew and procedures for operations, therefore road cranes are not explicitly covered in this handbook.

There are a number of legal regulations that cover safety in general at Middleton, such as the Health & Safety at Work etc. Act (1974). However, there are also more specific regulations for lifting – the Lifting Operations & Lifting Equipment Regulations (1998), commonly known as LOLER. Further guidance can be found on the Health & Safety Executive website (www.hse.gov.uk).

The minimum number of people involved in craning depends on the lifting operation being undertaken, however it will always require at least a Crane Driver and a Banksman. Where further assistance is required, at least one Slinger may be brought in to assist.

Anyone interested in being involved with craning must first gain some practical experience acting as a Slinger and working under the supervision of a Banksman.

Once certified competent as a Banksman, you may then undertake lifting operations without additional supervision, and may even be able to progress onto learning to become a Crane Driver.

Due to the need to ensure Crane Drivers can maintain sufficient experience of operating cranes, the number of Crane Drivers at Middleton will be limited.

Middleton Railway – Lifting Plan

Date:		Time:		Location of lift:		
Type of lift	Crane ☐	Hoist ☐	Jack-ing ☐	Internal / External		
Description of load/lift:						
Estimated weight to be lifted:		Number of lifting/jacking points in use:				
Any other considerations of load (e.g. shape, centre of gravity, constraints):						
If craning;						
Crane to be used		Yellow ☐	Grey ☐	Other ☐		
Daily inspection of crane completed?		Yes ☐	No ☐			
Crane driver:		Banksman:				
Will additional people be required to assist (e.g. slingers, ropers)		Yes ☐ No ☐	If yes, how many:			
Slings in use	2-leg ☐	4-leg ☐	5t fab-ric ☐	10t fabric ☐	Other ☐	None ☐
Are slings within inspection date:	Yes ☐	No ☐				
Is crane required to traverse during lift		Yes ☐	No ☐			
Is crane required to tail round during lift		Yes ☐	No ☐			
Can the crane safely reach the load without other measures		Yes ☐	No ☐			
How will any traversing and/or tailing round arrangements be managed:						
Are there any hazards present (such as underground services, overhead cables etc.):						
Signed	Crane Driver		Banksman			

Position of Crane at end of work

At the end of crane operations for the day, the jib should be set to the park position and set to the corresponding radius;

Yellow Crane 7 Ton position.

Grey Crane 4 Ton position.

The crane body must be positioned in line with the track, and facing an appropriate direction depending on where the crane is to be stabled. The hook should be lifted above building height,

All operating levers must be set to disengaged / neutral position, any windows and doors closed, the parking brake applied, and the battery isolation switch set to off" (Yellow Crane, also remove battery link) or removed (Grey Crane). Any defects or maintenance issues should be logged in the crane log-book and the Mechanical Engineer notified.

The crane must not be left parked with a load on the hook.

Other Vehicles

If any other vehicles have been used in the lifting operations, they should be returned to an appropriate stabling location as advised by any instructions or a Senior Engineer. The loads on vehicles must be left secure, and any vehicles must be stabled securely with appropriate

Roles & Responsibilities of Staff Involved in Craning

Crane Driver

This is the person who operates the crane, following the instructions of the Banksman. Operation of the crane includes moving the crane under its own power and using it for lifting operations. The Crane Driver is in overall charge of lifting activities and must ensure they are being undertaken safely. Due to the responsibilities involved in driving a crane, only persons 21 years of age and older may undertake this duty, and must satisfy the requirements of the railway medical policy.

Banksman

This is the person who is responsible for communicating with the Crane Driver and ensuring activities outside the crane are being managed safely. The Banksman may work on their own, or with assistance, but only the Banksman (or person under training and direct supervision of the Banksman) may signal to the Crane Driver. Only persons 18 years of age and older may undertake Banksman duties, and must satisfy the requirements of the railway medical policy.

Slinger

This is the person who attaches and removes lifting equipment, under the supervision of the Banksman; for simpler lifting operations, the Banksman may undertake the duties of the Slinger. The role of Slinger is where training and experience of craning begins, and will always

be under the direct supervision of the Banksman.
To undertake Slinger duties, persons must be a minimum of 16 years of age, with no specific medical requirements apart from being physically able to safely undertake the duties.

Only certified competent persons may act as a slinger unless under supervised training.

Signing in for Duty

This is a requirement of the railway to record who is on duty at the railway, and also a record of staff declarations that they are fit for their duty. Fit for duty requires people to not be under the influence of alcohol or drugs (prescription or otherwise), nor suffering fatigue or other illness that may impair their ability to safely carry out duties at the railway. At any point during the course of duty should a member feel unwell, they must immediately stop what they are doing and advise the Crane Driver or a Senior Engineer, who will arrange appropriate care and relief of duties if required.

Notices

These are displayed around the main entrance to the workshop and signing-in point, however they may also be displayed elsewhere around the railway premises as required. Notices specifically relating to craning activities will be displayed on the notice board above the signing in point, and all staff must review this notice board to ensure that any notices that may apply to craning duties are observed.

The design limitations of the lifting system as a whole are, of course, related to the weakest component in that system. This includes the lifting accessories such as slings, shackles, etc. which are attached to the load and will often dictate the maximum allowable lift.

Any instructions issued by the Mechanical Engineer regarding the capabilities of the crane.

Completion of Craning

Upon completion of craning, all lifting equipment must be removed and the crane must be left stabled securely in its designated place. All controls must be left disengaged, the lifting brake on, and a travel brake applied.

Grey Crane—External brake on East Side.

Yellow Crane—Wheel Handbrake (In cab—RHS)

Returning Equipment

All equipment such as slings, scotches, personal protective equipment etc. must be returned to its designated storage location. If any piece of equipment is defective, this should be marked as such and the Mechanical Engineer notified.

Safety Load Indicator (yellow crane only)

A Safe Load Indicator sounds an audio and visual warning that the safe working load is close to or has been exceeded.

On the yellow crane, the safe load indicator is in the cab to the front right of the crane driver's seat. The safe load indicator displays;

a green light to show the system is operational

an amber light is displayed when the load has reached approximately 90% of the SWL of the crane

a red light is displayed and an audible warning bell sounds when the crane has reached 100% of the SWL.

It is the Crane Driver's responsibility to prevent the crane from becoming overloaded; should an overload warning be given, immediate action should be taken to return the crane to a safe condition (generally achieved by reducing the radius). The Crane Driver must **never lift a load** if an overload signal is being registered before the load is fully lifted from the its stating location.

The Crane Driver should not rely on only the load indicators to determine if it is safe to lift a load at a given radius, other factors including but not limited to are;

Wind speeds in excess of those considered safe

Suitable Clothing & Personal Protective Equipment (PPE)

All staff involved in craning must wear suitable clothing and sturdy, steel toe-capped footwear. Staff must also wear appropriate, well-fitting hard hats – they must not be too loose and can be adjusted to ensure a good fit. Gloves may be required and should be worn as necessary depending on the task. Hard hats and gloves can be provided by the railway, please just ask.

The Banksman should wear a designated high visibility coat or vest with the word 'BANKSMAN' on for ease of identification. The Crane Driver need not wear high visibility clothing, however may wish to do so, again for ease of identification when not on the crane.

Crane Overview

The current fleet of cranes at the Middleton Railway are detailed below;

Yellow Crane No 24579

Manufacturer	Thomas Smith & Sons Ltd. Rodley, Leeds
Year	1960
Weight	25 tons
Minimum radius	12 feet
Max load @ min radius	10 tons
Maximum radius	25 feet
Max load @ max radius	1 ton

All crane functions are powered from a diesel engine. Operation of controls is by means of levers using cone clutches for hoisting and slewing. Travel and derricking is via a hand lever moving the relevant gear chain. Foot brakes are provided for travel, slewing and hoisting.
A further wheel brake is provided to act as a handbrake / parking brake.

Working on / from Vehicles

Craning can quite often require lifting a load from or onto a railway or road vehicle such as flat wagon or locomotive. In such cases, the vehicle that the load is being lifted to or from must be secured with the handbrake and wheel chocks as necessary to prevent any movement of the vehicle.

Access to the vehicle must also be considered and gained appropriately. The use of ladders may be required to access a vehicle, or to remove the sling(s) from the load.
No attempt to signal the Crane Driver must be made whilst using a ladder.

When loading wagons, the load(s) must be placed in a balanced manner on the vehicle, so as not to unevenly distribute the weight on the wagon, as this can cause the vehicle to become dangerous and in extreme circumstances pose a derailment or overturning risk.

Any loads moved onto a vehicle must be adequately secured, even if the vehicle is not planned to be moved as part of the lifting operation. Some loads may be heavy and of a uniform size that do not require any straps or similar to secure the load, however the Banksman and / or Crane Driver should always be consulted if there is any doubt

Specific Considerations When Lifting

Specific considerations will exist for just about every load that is moved, however some loads may require more attention that others…

When moving long rails which tend to droop at the ends try to pick up with the rail body in vertical alignment.

Persons ***must not*** ride any hoisting device, such as a hook, load or sling.

When not attached to the load, the hooks on slings should be placed on the link to minimise the likelihood of them catching on other objects when they are being moved.

The slings should be raised above head height before the crane is moved wherever possible.

A 24v DC electrical circuit is available for engine starting, safe load audible warning device and inspection lights.

Yellow Crane

Grey Crane No 20054

Manufacturer	Thomas Smith & Sons Ltd. Rodley, Leeds
Year	1953
Weight	25 ton
Minimum radius	18 feet
Max load @ min radius	5 tons
Maximum radius	35 feet (On screw Jacks)
Max load @ max radius	1¼ tons (On screw jacks)

This crane was converted from a steam crane. The boiler has been replaced with a diesel engine driving the original crankshaft via a torque convertor and chains.

The original steam engine cylinders and valve gear have also been removed.

Operation of controls is by means of levers using gears and dogs for hoisting and traveling. Cone clutches are used for slewing.

Travel and derricking is via a hand lever moving the relevant gear chain.

A 12v DC electrical circuit is available for engine starting, audible warning device and interior lights,

Lowering the Load

Once the load has been moved to where it needs to be positioned, the load should be carefully lowered.

Ensure the area for the load is clear of obstacles and is level. It may be necessary to build up the area with timbers or similar to ensure level

The load should be placed on some sturdy pieces of wood that are at least the depth of the sling. This is to enable the sling(s) to be removed and also for a lift to be achieved at a later date if needed, and to ensure that the load will be stable when positioned.

Ensure all personnel are clear and that nothing can become trapped

When the load has been fully lowered, slack will be observed in the sling(s). At this point, the Banksman should signal to the Crane Driver to lower the hook as much as possible to enable the sling(s) to be removed.

Checks During Lifting Operations

The Banksman and Crane Driver must keep a continuous eye on the lifting operation to ensue that no issues arise. The following checks should be made;

Keep a check on other activities within the crane working range to avoid the development of unforeseen hazards.

Listen for unusual engine and/or machinery noises.

Operate the crane controls as smoothly as conditions will allow and try to avoid 'snatch' as shock loading imposes undue strain on the crane and equipment.

Be aware of slight shocks which could indicate bad spooling, fouled gears etc.

The working area remains clear of personnel not involved in the lift

The jib radius does not exceed that permitted for the load

Slew gently, avoid side shock in the jib and slew gear, and help to avoid load swing tendencies which affect crane stability

Where practicable, correct load swing by engaging the slew control to coincide with the direction of the swing of the load

The load should be at the minimum height possible

Be careful the hook is not lifted too high that it comes into contact with the jib.

If anything out of the ordinary occurs **STOP**!

Grey Crane

Equipment Required for Craning

Prior to undertaking any craning, the required equipment should be collected, noting only certified equipment may be used for lifting operations. This will typically include slings – either fabric or metal, timbers for lowering the load onto, ropes for bigger loads that require stabilising during lifting, and any equipment necessary for securing loads such as ratchet straps. The equipment is usually found in the workshop and should all be available to hand prior to starting craning operations to ensure that there is no need to be looking for equipment mid-way through a lift.

Equipment Inspection

Before use, all lifting apparatus ***must*** be visually checked for signs of damage or wear – (see page 30 for further information on capacities.) This includes the crane (see page 12 / 14). and slings in particular. Slings, whether metal or fabric, are subjected to 6-monthly external inspections. However, as damage can occur at any time between these inspections, it is essential a visual inspection is carried out before use. For steel slings, particular attention must be paid to any signs of cuts into the metal or elongation of any part of the sling or hooks. For fabric slings, particular attention must be paid to any signs of cuts / slices and the condition of the stitching.

The Banksman is responsible, but that doesn't mean they have to attach them. A slinger could do it, but it would be under the supervision of the Banksman and to the Banksman's satisfaction..

A block of wood being used to stop chains sliding on load.

Lifting the Load

Once the load has been slung correctly and the necessary checks completed, the Banksman should signal the Crane Driver to take the weight of the load. This is a very gradual lift to a point where the entire load is lifted only a few centimetres; during this initial gradual lift, the slings may move and so hands must be kept clear of where they could be trapped. This is used to ensure that the sling(s) have been placed appropriately, that the lift is balanced and that the weight of the load is not excessive – this would be indicated by the operation of the safe working indicator on the crane (yellow crane only). Once the Banksman is satisfied that the load is secure, the lifting operation can continue until the desired activity has been completed, using the signals outlined on page 42.

Even once the weight has been taken, the slings may move along the load, particularly if the load swings or jolts. ***Hands must not be placed in between slings while a load is being lifted***.

Long or awkward loads may require handling lines (guide ropes) to be attached to ensure that swinging of the load is minimised. The Banksman is responsible for the attachment of such lines, where appropriate, and anyone operating these lines must work to the Banksman's instructions. The guide ropes should be attached prior to the load being lifted, and if there is any uncertainty as to whether they may be required, it is recommended that guide ropes are used.

- ***Inspection Tag, showing date equipment cannot be used after without 6-monthly inspection***

If any timbers, guide ropes or ratchet straps are to be used, these should also be inspected to ensure they can support the load to be moved and in its final position. Ropes and ratchet straps ***must not*** be used to support the load, but are used to guide a swinging load or secure a load to a vehicle once craning has been completed.

Any equipment found to be damaged must not be used, but labelled as defective and the Crane Driver and Mechanical Engineer advised.

If there is any doubt as to the condition of any equipment, do not use it, and report this to the Crane Driver or Senior Engineer

Preparing A Crane For Use

The crane and its associated equipment must be maintained in a condition that will not endanger the Crane Driver or any other personnel, nor risk causing damage to the infrastructure.

Cranes are subjected to a third-party inspection, typically undertaken annually, but it is important that a visual inspection is also undertaken prior to each use.

An inspection checklist is provided for the cranes and must be completed prior to use by the Crane Driver. As part of the in-service inspection, if a defect is noted, this must be reported on the examination sheet and to the Mechanical Engineer or appropriate Senior Engineer.

Crane Travel Signals (Normal Shunting Signals)

When it is required for a crane to move under its own power, normal shunting signals must be used. (Page 19)

These signals apply to use by a Shunter or Banksman.

Signals do exist for moving vehicles in poor visibility, however craning operations should not be undertaken in these conditions, and so it would only be an out-of-course situation that would require signals to be given during poor light, in which case a suitably competent person must be consulted.

Preparing to Lift

Once the slings have been passed around the load, in preparation for lifting, the Banksman must check the following:

The sling(s) is free of kinks or twists and will lift clear of other items when taking the strain.

Where multiple slings are in use, that they are not wrapped / twisted around each other

The sling(s) are securely attached to the hook block

The position of the sling(s) is such that the load will be balanced when lifted

The sling(s) and load will clear all obstacles or obstructions

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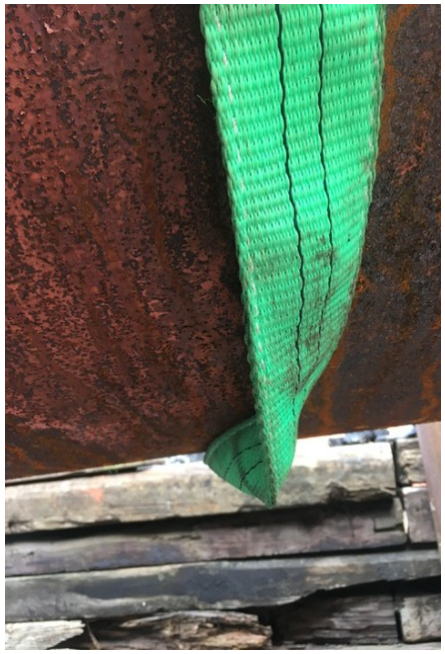
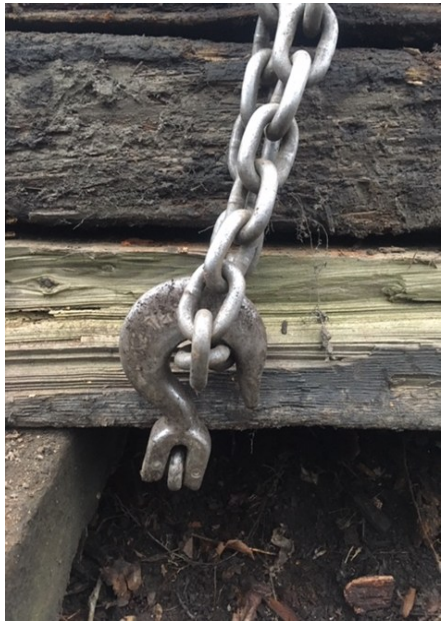


INCORECT



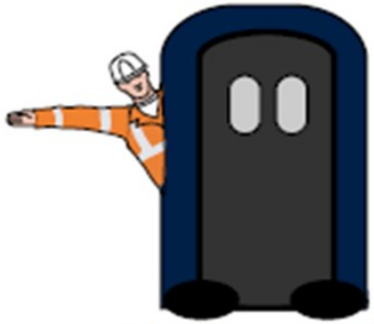
Move away from the shunter

Move towards the shunter

Slow down

Stop immediately

Ease up



Stop immediately when on a vehicle

Crane Travel Restrictions

All cranes are to be treated as ***out-of-gauge loads*** – meaning it cannot be assumed that the vehicle will clear all lineside structures, and as such extreme care must be taken when moving cranes close to or past lineside structures or vehicles in sidings. If cranes are to be stabled on lines running into buildings, careful attention should be given to the possibility of the jib or hook coming into contact with the building at high level.

A crane may propel itself within Moor Road yard and within the limits of a working area / engineering possession.

The **yellow crane** will only travel through the tunnel with the jib lowered to the North (i.e. pointing towards Moor Road) as the cab side sticks out further than the other side, and the tunnel is not symmetrical.

The jib must face South (i.e. pointing towards Park Halt) to pass the water tower.

The **grey crane** is symmetrical and can travel through the tunnel facing in either direction with the jib lowered and parallel with the running rails. The crane can also pass the water tower with the jib facing in either direction, but again, the body must be parallel with the running rails.

Lifting

The Banksman should signal the Crane Driver such that the hook is carefully positioned over the load, in approximately the position where the slings will be placed. The hook should be lowered to such a point that the slings can be attached, again following signals from the Banksman.

Slinging

When slinging, the appropriate method of wrapping the sling(s) around the load must be chosen. If using fabric slings, an appropriate length sling must be used.

There are several options for lifting something with steel chain slings. A single leg can be used on occasions, but it is often necessary to use more than one leg; either 2 or 4. Again, sling length should be considered, however with the 4 legger chain slings, the length can be adjusted to suit.

Some objects may have handrails or similar that can be used to attach slings to, however if something like this is to be used, there must be no danger of the handrail or similar becoming loose or detached from the rest of the item being lifted.

Where handrails or similar do not exist and the slings may not pass all the way round, such as locomotive cabs, scaffolding poles can be used through spectacle plates to lift the cab. This method may also be used for other items. Practical experience will guide on methods of slinging and lifting bulky items.

Other Considerations

All personnel are responsible for the safety of both themselves and others within the working area.

Other considerations that should be made when preparing and planning lifting operations include, but are not limited to;

Hands must never be placed under loads, unless the load is in a definitely secure position. If passing chains or straps under loads, the use of a hooked bar should be considered.

If loading or unloading from a wagon, ensure the wagon is secured to prevent movement.

Guide ropes may be required to hold a load steady and guide the load into position – particularly for bulky loads.

If the track is not level, consider if the crane needs extra chocking to supplement its own brakes. Also, be aware that the effective radius will change as the crane is slewed.

Loads moving onto and off of vehicles can cause movement of the crane or the vehicle if the load catches or snags during the movement. Be aware of the risk of this happening. **If in doubt, keep clear**.

The crane must not be used to make a side pull, or any lift outside the jib radius.

Where a crane is being moved outside Moor Road yard and not within a working area or engineering possession, a locomotive ***must*** travel on the ***North*** side of the crane (other vehicles may be between the locomotive and crane as required). This is because the cranes have no continuous brake (e.g. vacuum brake), and so are unable to stop themselves running away downhill should a coupling fail.

Consideration must also be given to any vegetation by the side of the line, to ensure that when the crane is moving either under its own power or as part of a train, the jib is clear of trees etc.

Moor Road Yard

The main overhead obstructions include trees by the west side of the site, and by the platform run round loop.

Limits to slewing to be aware of include buildings, fences, coal stage, water tower, parked rolling stock and the containers.

If travelling through the workshop or into other buildings, the jib **must** be lowered before entering the building.

South of Tunnel (Towards Park Halt)

Main overhead and slewing obstructions include school road bridge, school pedestrian bridge, and vegetation along the line, particularly by the top curve near Park Halt.

Balm Road Branch

Main obstructions include telephone wires crossing the railway line by Moor Road gate, trees below Moor Road, crossing gates on bottom loop.

As the cranes do not often leave Moor Road site, it is prudent to walk the section of line where the crane will traverse (either under its own power or being propelled with a locomotive) to identify any potential obstructions and hazards to its safe movement.

Crane Driver Visibility

Our cranes have very limited visibility for the Crane Driver. Due to the nature of the cranes and cabs, there is practically no visibility to the rear and sides, and forward viewing can be obstructed by the jib. The Banksman must ensure he is in a position of safety i.e. appropriately clear of the load and crane, but still visible to the Crane Driver for signalling. If the Crane Driver cannot see the Banksman, the movement or lifting operation must stop until the Crane Driver is satisfied that the movement or lifting operation can safely resume.

It is essential that all personnel involved in lifting operations communicate clearly and unambiguously.

The Banksman will ensure that communications are clear.

Radio Communication

Instructions to the Crane Driver may also be given by radio communication.

The Banksman provides the instructions verbally over the radio, and ideally should be constantly talking whilst the crane is moving to ensure that the Crane Driver knows the Banksman and other personnel are safe. The Crane Driver is not necessarily required to respond to the instructions (i.e.) by repeating them over the radio) other than to follow them.

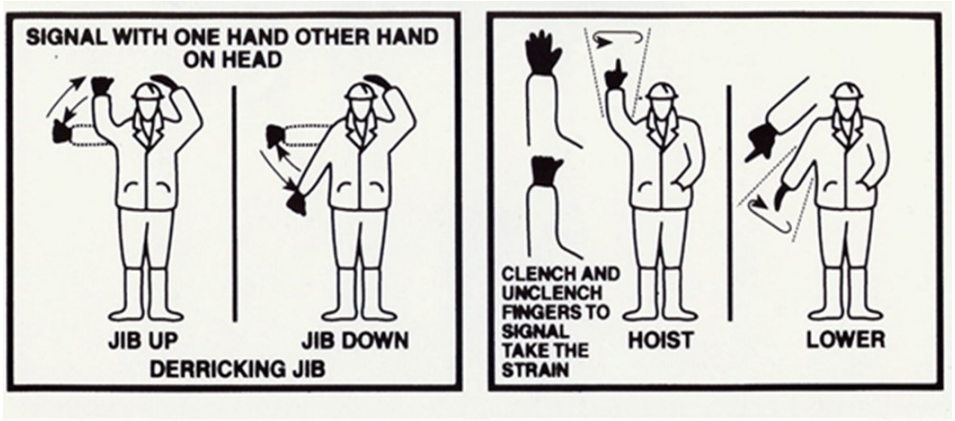
Prior to the use of radios, a functional test of the radios must be undertaken.

Crane Drivers Visibility

The cranes have very limited all round visibility, especially to the sides and rear, so the Banksman or a person nominated by the Banksman will be required to watch the rear of the crane to ensure the rear does not foul any other objects whilst slewing.

Lifting Signals

When the crane is undertaking lifting, lowering, derricking or slewing operations, the following signals must be used by the Banksman (or Slinger under supervision), giving due consideration to the visibility available to the Crane Driver.



Crane Movements to Move a Load

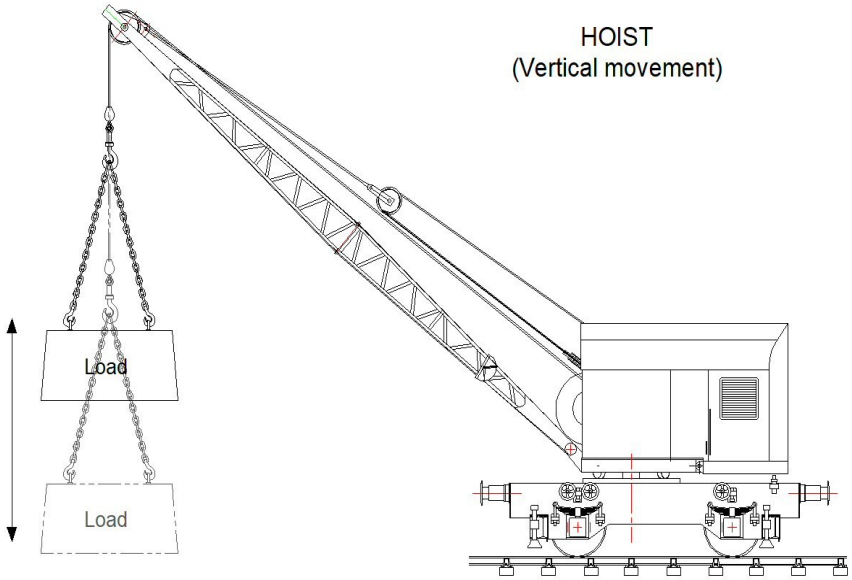
Movements of the crane to move the load can be undertaken in a number of ways. The terminology for these movements is;

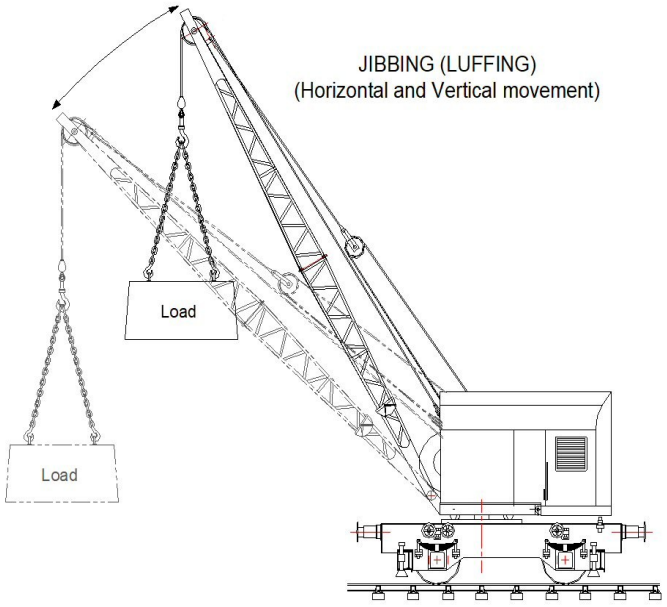
Lifting / Lowering (Hoisting) – where the hook is lifted or lowered, generally without the jib moving (although the load can be lifted or lowered using the jib, see jibbing below).

Jibbing, Luffing or Booming (Up / Down) – where the jib is moved up or down to adjust the radius of the crane (to alter the reach and or capabilities of the crane as required). This movement will also cause the hook to lift or lower slightly.

Slewing / Tailing Round – where the load is rotated by movement of the crane body.

Crane Diagrams





Banksman

The Banksman will control the operations through communication with the Crane Driver and any Slingers that may be present. The Banksman will also ensure the general site safety of the working area, which includes loading and unloading sites, in addition to anywhere that the crane may traverse during the operation. The working area must be clear of unwanted items, and non-essential personnel must also be kept away from the working area.

The Banksman, in liaison with the Crane Driver, will be responsible for assessing the load in terms of shape, size, weight and balance. By using judgement gained from experience, the lifting equipment can then be placed on the appropriate part of the load to ensure a safe lifting operation.

All hand signals and / or radio instructions given to the Crane Driver will be given by the Banksman only.

The only exception is an Emergency Stop (see page 42, which, if required, should be given by any person working on the operation.

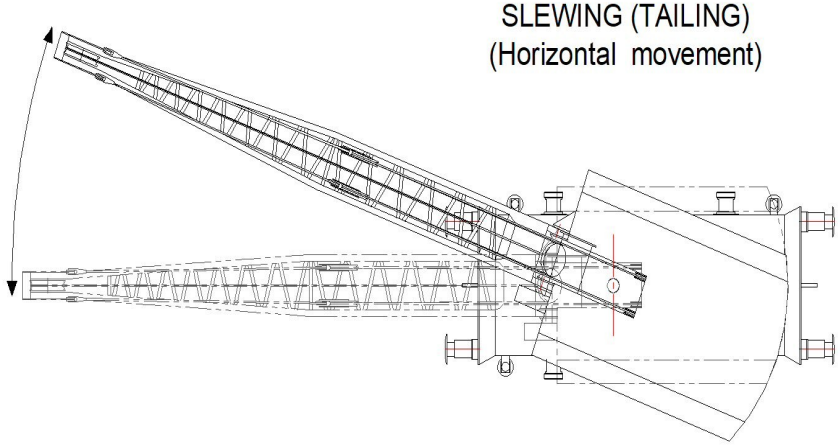
Pre-lifting Considerations

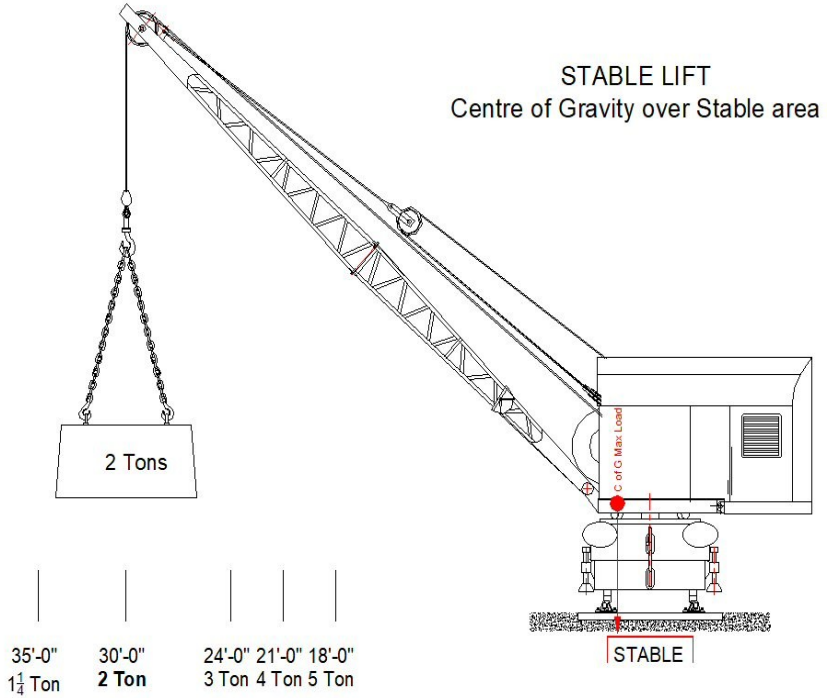
The following considerations should be made as part of the preparations to commence lifting operations;

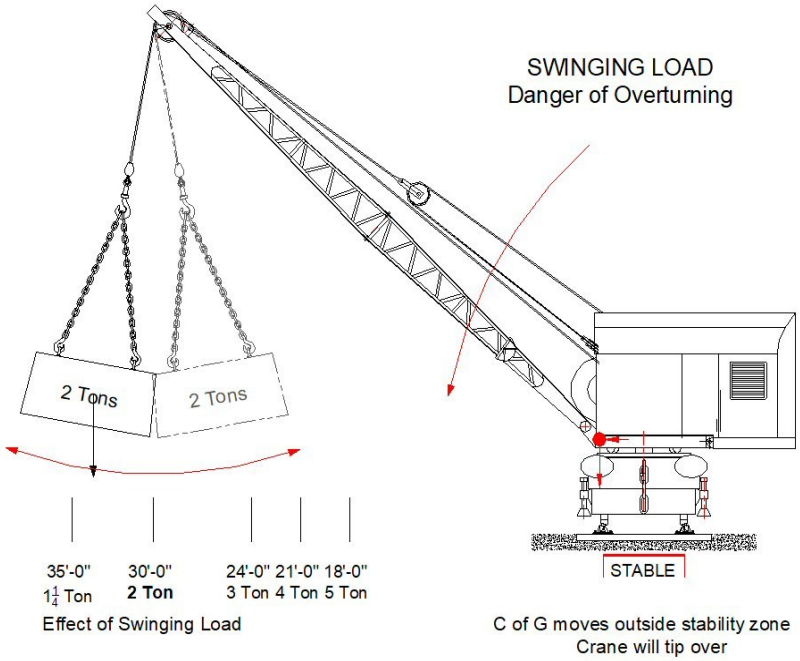
Working Area Planning

Many of the crane operations are likely to take place in restricted locations, particularly in Moor Road yard; that is there are obstructions such as buildings or trees in close proximity. It is essential that all working areas are carefully inspected prior to operations commencing, to ascertain the areas of concern that may cause interference with slewing, jibbing, or crane travel, particularly giving consideration to the crane body having a large rear overhang that cannot be seen by the operator, therefore it is likely slewing constraints will exist and these must be identified and documented prior to operations commencing.

All lifts must take place in accordance with an agreed lifting plan, which must be completed for complex lifts, and must be completed before the lift takes place. Any relevant local conditions that may affect the lifting operation must be incorporated into the lifting plan.

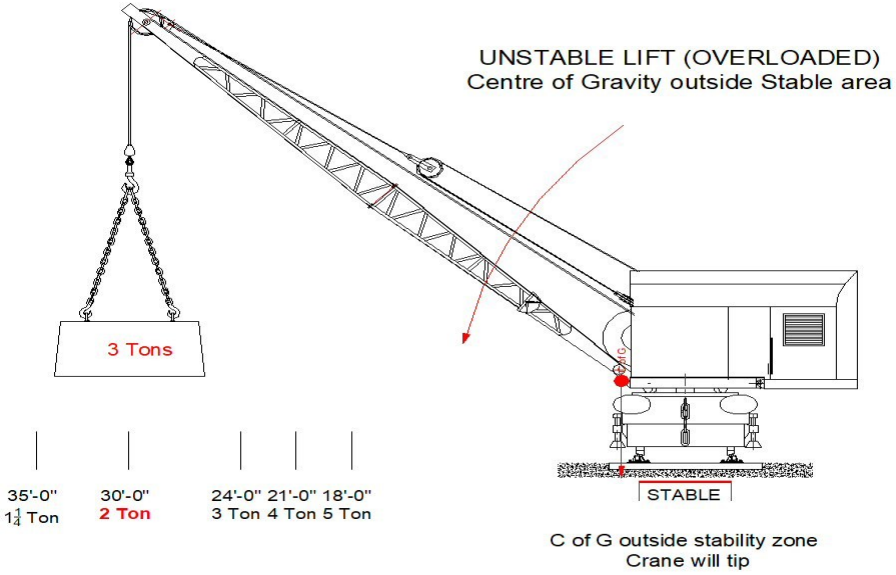






Effect of Swinging Load

C of G moves outside stability zone
Crane will tip over



C of G outside stability zone
Crane will tip

Where complex or multiple lifts are being undertaken, it is best to break down the operation into stages.

The Banksman should ensure all personnel involved come to a clear understanding of the next stages of lifting at suitable points, and if at any time the understanding breaks down, lifting operations must be safely halted until a clear understanding is restored.

Lifting Plan

Before commencement of operations, the Crane Driver and Banksman must complete a lifting plan (see page 57), including what is to be lifted, equipment to be used, method of lifting, any potential hazards and the mitigation precautions and any special considerations.
Completed lifting plans will be kept in the designated folder under the signing on desk,

Safety Briefing

Before commencement of operations, the Crane Driver or Banksman must undertake a safety briefing with all personnel involved in the lifting operations, providing a brief of the lift and hazards and based on the completed lifting plan. There is no template for the briefing, however the details completed on the lifting plan will provide the details necessary to be briefed to the personnel involved.

The brief will review the planned operation, along with the lifting equipment and methods to be used, whether there are any particular hazards to be aware of in the working area (e.g. restricted clearances, overhead obstructions, etc.), and any planned vehicle movements.

The safety brief is an essential part of ensuring that all personnel involved with the lifting operations come to a clear understanding prior to any movements or lifts taking place.

Crane Stability

Stability is very important where any crane is concerned. If a crane, or any object, is in **no danger** of falling over, or **tipping**, it is said to be **stable**. When it approaches the point where it can be easily **tipped**, it is said to be **unstable**. The **stability** of rail-mounted cranes depends on various elements;

1. **The loads the cranes can lift.**
   The stability of the cranes – at Middleton is based on them being ‘free on rail’, that is they require no additional support or ground stabilisers.

Some rail-mounted cranes are fitted with **outriggers** (the grey crane only), which are used to increase the stability base, however the increase in stability these provide is negligible and so are rarely used.

2. **Centre of Gravity**

Every object has a centre of gravity; it is the point where the weight of the object is exerted vertically downwards and is also the point of balance.

If the centre of gravity of a crane is supported from below (i.e. within the stability base) then the crane will be stable. If it is not supported, in other words, if it moves outside the stability base, then the crane will tip over.

Where a crane is concerned, the centre of gravity does not stay in the same place, it moves depending factors such as if the load weight is changed (increased or decreased),

and /or the radius is changed. Of particular importance is also the track condition, ensuring there is a good cross level and that the track where the crane is operating is not twisted. Where there is a poor cross level (or twist) in the track, one or more crane wheel may come out of contact with the rail and be unsupported. Under these conditions, the crane becomes unstable and is liable to derailment or even topple.

3. **Safe Working Load**(**SWL**)

This is the load that the crane can lift safely at a given radius. The SWL may also be known as duty, capacity, rating or rated load. As the radius changes, so does the SWL, with the crane being capable of lifting a greater load at a smaller radius. Cranes typically have a load indicator on the side of the jib that shows the current radius and therefore the SWL.

All equipment involved in lifting operations has a SWL, such as slings or lifting jacks, and so the load being lifted is limited by the lowest SWL rating of any single piece of equipment being used. This is why it is important to ensure that the correct rating lifting equipment is being used.

When considering the load, ***anything*** that is attached to the jib is considered to be part of the load; this includes hooks, slings, any attachments, and of course, the load being lifted.

Site Obstructions

The position of overhead and adjacent obstructions, (trees, telephone lines, bridges, tunnel etc.), must be observed, as well as any close proximity to buildings, rolling stock or other trackside obstructions.

An awareness for the potential for these obstructions to be present needs specific consideration when a crane is required to travel, tail round or the jib is being raised or lowered.

The final unloading position(s) for the item(s) being moved should also be checked to be seen to be clear of obstructions prior to beginning lifting, so as to ensure that the load is not suspended for any longer than absolutely required.

Working Area

The working area is the area defined as where lifting operations and crane movements will be taking place. The working area will be unique to the lift being undertaken and may change depending on the stage of lifting operation. The working area must give adequate consideration and clearance for the lifting activities and crane movements to be undertaken.

Only personnel involved in the lift and associated activities should be allowed into the working area. At the safety briefing talk (see page 38), emphasis should be placed on safety awareness, in particular the hazard from a slewing load, with which some volunteers may be unfamiliar.

Any person not involved with the operation must be kept away from the working area. If any unauthorised person encroaches too close, or within the area, then the operation must be stopped and not resumed until the area has been vacated by the unauthorised person(s).

4. Radius and Jib Angle

The load that any jib type crane can lift will depend on a measurement known as **radius** (or jib radius). This is the distance from the **centre line of rotation** to the **vertical load line**, where;

The centre line of rotation is the very centre of the swing joint (usually the **centre pin**) and never moves in relation to the crane, and;

The vertical load line is the line drawn from the jib head, straight downwards.

The radius changes as the jib is raised or lowered. Cranes also have a **tail radius** (or tail swing). This is the furthest projection **behind** the centre line of rotation.

Any jib crane will have a **minimum** radius, and a **maximum** radius (see pages 12 / 14 for the radius range of cranes at the Middleton Railway), this is dependent upon the length of the jib.

Lowering of Jibs

The only time the jib may be lowered **below** the minimum jib angle, or **outside maximum radius** is when it is being brought down to rest, **never** with a load attached.

If the jib is lowered below the minimum angle on the Grey crane, a wooden packing **must** be placed over the lifting drum rope to prevent damage to the lifting rope by the jib pulley resting on it.

Typical Lifting Capabilities & Loads

Lifting Equipment

All lifting equipment will have its own safe working load; if it is not clearly marked, consult a Crane Driver or Senior Engineer for guidance. Typical SWLs of the lifting equipment at Middleton is as follows;

Steel slings	Short 2 leg	2.4 tonnes
	Long 2 leg	5 tonnes
	4 leg	5 tonnes
Fibre slings	Green	2 tonnes
	Grey	4 tonnes
	Orange	10 tonnes

Steel slings are formed of several parts; the hook, legs, shortening clutches and ring. As the legs of the sling may be longer than required, some steel slings are provided with shortening clutches. These enable the chain length to be adjusted to suit the lift, (Asymmetric Load). Whenever more than one leg of a sling is being used, and being used at a shortened length, care must be taken to ensure each leg is shortened to the same length – this is usually achieved by counting the number of links from the ring to the adjuster.

Remember — All lifting equipment must be checked for condition before each use.

Loading of slings and Chains

If using a multi-leg sling to lift something the chains will not be vertical and they will be at an angle to each other.

The forces on the chain thus have horizontal and vertical components.

The greater the angle, the greater the horizontal component. if the sling is hitched round whatever is being lifted It is only friction that stops the chain from moving due to the horizontal force. This is particularly the case when lifting rails, (which is why it is suggested using a piece of timber as that increases the friction.).

A sling sliding in this way has a real possibility of being cut through and failing.

Another point frequently not understood is that, increasing the angle between the chains increases the load on them. Once the included angle exceeds 90 degrees, the safe working load reduces. If the included angle reaches 120 degrees, the SWL is halved.

Static and Dynamic Loads

Any person involved in craning operations must give consideration to **static** and **dynamic** loads, and the conditions that affects these.

A **static** load on a crane means that the effect of the load on the machine never becomes greater that the weight of the load. If slow and steady movements of the crane and load are undertaken, the load can generally be considered a static load.

However, there are circumstances where the effect of the load on the crane is **more** than the actual weight of the load. This can happen for a variety of reasons and are known as dynamic loads:

Sudden acceleration in the hoist or jib systems.

Swinging loads, in any direction

Loads that are lowered quickly and stopped abruptly

The most common cause of this potentially dangerous situation is when the load comes onto the crane suddenly. A way to mitigate this is to ensure slings are brought under tension as **slowly as possible**. When lifting a load, once the slings have been placed around the load, the Crane Driver should be instructed to take the strain, which is a slow movement to get to a point where the crane has just taken the weight of the load, evident by the chains being in tension.

Damage to the crane caused by shock loading may not be immediately visible, but monitoring and experience have shown that the cumulative effects can, and do, lead to serious faults in both the structural and mechanical components of the crane, which can lead to sudden catastrophic failure.

When using the 4 leg slings, always ensure that the two chains from the same Brother ring are used together, i.e. If only using two chains, use the same pair from one ring.

Keep chains straight and not twisted.

When chains are not attached to a load, they must always be placed in a ring.

Sample Loads

The following provides guidance as to typical weights of items that are more frequently lifted at Middleton.
Each load should be considered on its own merits as to weight, and it is always better to over-estimate.
Knowledge of typical weights for lifts is only gained through experience, although if there is any doubt, consult a Crane Driver or Senior Engineer.

Sleepers & Point Timbers;

Wooden, softwood 8ft 6in – 110lb (50kg)

Note: wooden sleepers can vary considerably across individual sleepers

Concrete, 8ft 3in – 550lb (250kg)

The longer the sleeper, the greater the weight, in line with above weights. Add 55lb (25kg) for each chair that is attached to sleeper being lifted.

Point timbers are a different cross-sectional area and are approximately 1½ times heavier than a wooden sleeper for the same length

Rail;

20ft (6m) length – 660lb (300kg)

60ft (18m) length – 1870lb (850kg)

The above are for bullhead rail. Flat-bottomed rail, whilst not currently used at Middleton is approximately 15% heavier at 2200lb (1000kg) per 60ft (18m) length.

20ft track panel, assembled;

Wooden sleepers – 1920lb (1325kg)

Concrete sleepers – 6600lb (3000kg)

Miscellaneous

Steam loco water tank* – 3300lb (1500kg)

Steam loco cab* – 1100lb (500kg)

Steam loco boiler (empty)* – 8800lb-15400lb (4000kg-7000kg)

Loco wheelset* – 2200lb (1000kg)

These items can vary considerably in weight and should be calculated prior to lifting. Steel weighs 10lb per square foot per ¼" thickness (50kg per square metre per 6mm thickness), so by measuring the thickness and size, the weight can be calculated.

If in doubt, consult with the Crane Driver or Senior Engineer.

If required, load weights can be checked using the crane weigh device.

Weight Conversions

1 Ton = 2240 lbs

1 Ton = 1016 Kg